The invention relates to a jet propulsion engine, especially for watercraft, comprising a rotor on the inside of which blades are disposed, and a housing in which the rotor is rotationally received.

Such a jet propulsion engine is known from DE 39 12 910 C2 for example, with the rotor being configured here in the form of a pipe with an inside screw.

The drive of the engine can be realized mechanically or in the form of an electric ring motor, in which the rotor thus represents a part of the electromotor.

The problem of bearing between rotor and housing increases with rising diameter of the rotor.

Roller or rolling contact bearings must be sealed against penetration of water in the use of the jet propulsion engine for water vehicles.

Extensive trials have shown that sealing can be achieved with a high amount of effort, but the stability over time has proven to be a serious problem because with beginning leakiness there will be damage to the bearings within a very short period of time.

The invention is therefore based on the object of providing a bearing for the jet propulsion engine as mentioned above which ensures a long service life.

Moreover, the bearing should also enable the realization of large rotor diameters for powerful jet propulsion engines.

This object is achieved in accordance with the invention in such a way that the bearing between rotor and housing comprises carbide that is resistant to sea-water.

By using carbide that is resistant to sea-water it is no longer necessary to seal the bearing, so that the damage to the bearing is excluded right from the beginning when leakiness occurs.

Silicon carbide or aluminum carbide is preferably used, because these two materials, and silicon carbide in particular, have a high resistance against sea-water and also offer the required strength.

It is further advantageous to provide the bearing between rotor and housing exclusively from carbide because any materials additionally used for the bearing are either not corrosion-proof or have a lower resistance to sea-water, which would lead to premature wear and tear of the bearing.

As a result of the favorable sliding properties of the carbide in conjunction with a water film, the bearing is advantageously configured as a slide bearing.

According to a preferred embodiment, the bearing in the rotor and/or the bearing in the housing is formed from several bearing segments.

In the case of large diameters of the bearing it is virtually impossible to produce the bearing made of carbide in an integral manner. By producing the bearing by way of several bearing segments it is possible to realize diameters of virtually any size.

In the configuration of the bearing by several bearing segments it is advantageous to arrange the bearing segments in a spaced manner at least on the rotor, so that as a result of centrifugal force the water is pressed outwardly between the bearing segments and thus a pumping effect is achieved.

As a result of the pumping effect, there is an inevitable flow about the bearing segments, leading to an improved heat dissipation.

Especially in the case of a configuration as an electric ring motor, the housing encloses the rotor in such a way that a hollow space is obtained between the outside of the rotor and the inside of the housing.

In this embodiment it is advantageous to space the bearing segments on the rotor on the one side of the bearing and to space the bearing segments on the housing on the other side, so that the water is pressed into the hollow space by way of the pumping effect through the spaced bearing segments on the rotor and can flow outwards again via the spaced bearing segments on the housing.

It is similarly also possible to space the bearing segments on the rotor on both sides, so that a pumping effect in the direction of the hollow space is obtained on both sides and the hollow space is opened in the direction of the outside for example by a bore in the housing or several bores in the housing, so that the desired flow for cooling the bearings and the electric ring motor can be produced.

The fixing of the bearing segments on the rotor or housing is advantageously made by positive locking, e.g. with the help of a trapeze geometry and subsequent gluing.

The invention is now explained by reference to an embodiment shown in the drawings, wherein:

Fig. 1 shows a side view of the jet propulsion engine in accordance with the invention;

Fig. 2 substantially shows the sectional view AA of Fig. 1, with the fixing device and the blades not being shown;

Fig. 3 shows an enlarged illustration of the lower part of Fig. 2;

Fig. 4 shows an enlarged perspective partial view of the bearing in the housing;

Figs. 5a and 5b show front and side view of a bearing segment for the rotor, and

Fig. 6 shows a partial circle of the adjacently arranged bearing segments on the rotor.

Fig. 1 shows a side view of a jet propulsion engine for water vehicles which is based on the drive concept of an electric ring motor.

The sectional view also shows a part of the boat hull 19 with an opening 20, through which the jet propulsion engine can be extended and retracted. A shaft 21 is formed for this purpose in hull 19, in which the jet propulsion engine is received in the retracted state.

The jet propulsion engine comprises a rotor 1 whose inner side comprises inwardly facing blades 2. The blades 2 are fixed to rotor 1 in a clamping manner and can each be exchanged individually.

Rotor 1 is received in a housing 3 which on its part is connected to a mounting 4.

The mounting 4 comprises a flange 5 towards the housing 3 and is connected via flange 5 with the housing 3.

The mounting 4 is arranged as a hydraulic cylinder which is fixed at its upper end by way of a screwed joint 6 to a cover 7 of the shaft 21.

The boat contains a generator (not shown) or any other power source which is usually a diesel generator which supplies the jet propulsion engine via line 8 with the required power.

The hydraulic cylinder 4 is received in a sleeve 22 with groove 23 for extending and retracting and for control of the jet propulsion engine, in which groove engages a pin 24 which on its part is fixedly connected with the cover 7. Pin 24 and groove 23 form a connecting link guide, so that in the straight part of the groove the jet propulsion engine can be extended and the jet propulsion engine is rotated in the spiral part of the groove.

Extension and retraction as well as control can thus occur via the hydraulic cylinder 4. For this purpose, it merely comprises an inlet 25 and an outlet 26 on the upper side.

A sealing plate 27 with a sealing bead 28 is arranged on the lower side of the sleeve 22 in order to keep the water from the upper part of the shaft.

Opening 20 can be sealed by means of a lamellar shutter 29 which can be closed by means of a drive 30 which is also in the form of a hydraulic or pneumatic cylinder for example.

The jet propulsion engine is shown in the extended state with the broken line.

Depending on the configuration of the jet propulsion engine, the same can be used as a main drive and also as an additional maneuvering aid because it can easily be swiveled about 360° and can be configured to extend and retract easily as a result of its low weight.

Fig. 2 substantially shows the sectional view AA of Fig. 1, merely showing the interior between rotor 1 and the housing 3 and an illustration of the blades 2 being omitted.

Fig. 3 shows the lower part of Fig. 2 on an enlarged scale.

Rotor 1 substantially consists of two rotor parts 1a and 1b which are jointly screwed together and centrically receive an electromotor rotor ring 9 on its outer side between themselves in a clamping manner.

The holding flanges 10a and 10b for fixing the blade segments are each provided on the sides of the rotor.

Rotor 1 is enclosed in a sleeve-like manner by housing 3, with the housing 3 also being formed by two housing elements 3a and 3b which are screwed together like the rotor parts 1a and 1b and receive between themselves a stator ring 11 for the electromotor in a clamping manner.

Rotor 1 is held by means of two slide bearings 12a and 12b relative to the housing 3 in such a way that a minimal air gap 13 is obtained between the electromotor rotor ring 9 and stator ring 11.

The bearings 12a and 12b are configured as carbide bearings in the form of silicon or aluminum carbide.

Carbide is sea-water resistant on the one hand and offers very favorable sliding properties in connection with water on the other hand.

In the illustrated embodiment, a slide bearing 12a or 12b consists of a rotor bearing 14 which is substantially rectangular on its free outer sides and two substantially radially and axially arranged housing bearings 15 which are arranged on the outsides of the rotor bearing 14. In the case of smaller diameters, the rotor bearing 14 and the housing bearing 15 can be produced in an integral manner. In the case of large diameters it is virtually only possible to realize a multi-part configuration of rotor bearing 14 and housing bearing 15.

Fig. 4 schematically shows a perspective view of the multi-part configuration of the housing bearing 15. The housing bearings 15 are provided with a configuration

which is substantially trapezoid in its cross section, so that they can be inserted into trapezoid grooves in the housing. As a result of the trapezoid configuration, the housing bearings are thus fixed in a positive-locking manner in the housing 3. They can also be glued together in addition.

After the fixing they are grounded again, so that a precise bearing is obtained despite the individual bearing segments.

Depending on whether a cross-flow shall be achieved in the housing bearing 15, the bearing segments 15 can be spaced from one another by a certain space d as shown in Fig. 4 or grooves can be formed on the bearing segments 15.

As a result of the distance d or the grooves, the bearing segments are thus continuously subjected to a flow, leading to an additional cooling of the bearing and the electromotor.

Fig. 5a shows a cross section of the rotor bearing 14 which comprises a trapezoid recess 16 on its inner side, so that the bearing can be fastened to the trapezoid bead on rotor 1.

The form-fitting fixture of rotor bearing 14 and housing bearing 15 is only necessary in the case of large diameters and the configuration of the bearing with several bearing segments. Carbide bearings with small diameters merely need to be glued.

The bearing segments of the rotor bearing 14 are additionally advantageously glued in the trapezoid recess 16 and thereafter ground over.

Fig. 5 b also shows the side view of a bearing segment 14. It is shown that the sides of the bearing element 14 are each radially rounded off.

Fig. 6 shows a partial circle of the bearing elements 14. It is shown that a tapering and then widening gap S is obtained as a result of the rounded parts on the side of the bearing elements 14.

A pumping effect is achieved by this configuration of the rotor bearing elements 14. The liquid which is located in the gaps S is pressed during rotation by centrifugal force to the outside and thus reaches hollow space 17 (see Fig. 3) which is obtained between the rotor 1 and the housing 3.

If the housing bearing segments are also spaced as shown in Fig. 4, the water pumped into the hollow space 17 can flow off again between the housing bearing segments 15.

It is similarly also possible to provide a bore 18 on the housing 3 through which the water pumped by the rotor bearing 14 can be discharged again.

In the case of very large engines it is also possible to connect an external pump to bore 18 which pumps filtered water into the hollow space 17 and thus produces a certain excess pressure and rinses the bearings with filtered water.

By producing the bearings exclusively from carbide, especially silicon carbide, it is possible to provide the bearing in a non-sealed way as a water bearing, thus preventing complex sealing and achieving excellent cooling at the same time by the water.

The invention is not limited to the illustrated embodiment. As a result of the high resistance to heat, the carbide bearing can also be used as a air bearing for an air drive.

It is relevant for the production that both the rotor as well as the housing including the bearing can be pre-mounted and ground.

The housing merely needs to be detached again for mounting and can be screwed together again after the insertion of the rotor.

List of reference numerals

1	Rotor
1a, 1b	Rotor parts
2	Blade
3	Housing
3a, 3b	Housing parts
4	Mounting, hydraulic cylinder
5	Flange
6	Screwed joint
7	Cover
8	Lead
9	Electromotor rotor ring
10a, 10b	Holding flange
11	Stator ring
12a, 12b	Slide bearing
13	Air gap
14	Rotor bearing
15	Housing bearing
16	Trapezoid recess
S	Gap
17	Hollow space
18	Bore
19	Boat hull
20	Opening
21	Shaft
22	Sleeve
23	Groove
24	Pin

25	Inlet
26	Outlet
27	Sealing plate
28	Sealing bead
29	Lamellar shutter
30	Drive